Oroville FERC Relicensing (Project No. 2100)

Environmental Work Group

Fisheries Task Force Meeting

June 8, 2004

SP-F15

SP-F15 Agenda Item #1 Overview of F15 Tasks

- **SP- F15 Evaluation of the Feasibility to Provide Passage for Targeted Species of Migratory and Anadromous Fish Past the Oroville Facilities**

SP-F15 Tasks

- **Task 1 – Life History and Habitat Requirements of Target Species**
- **Task 2 – Inventory of Potentially Available Habitat for Juvenile and Adult Fish Upstream of Lake Oroville**
- **Task 3 – Evaluation of the Methods and Devices Used in the Capture, Sorting, Holding, Transport and Release of Fish**
- **Task 4 – Decision Support Tool**

SP-F15 Task 1

- **Life history and habitat requirements matrices completed and submitted to DWR**

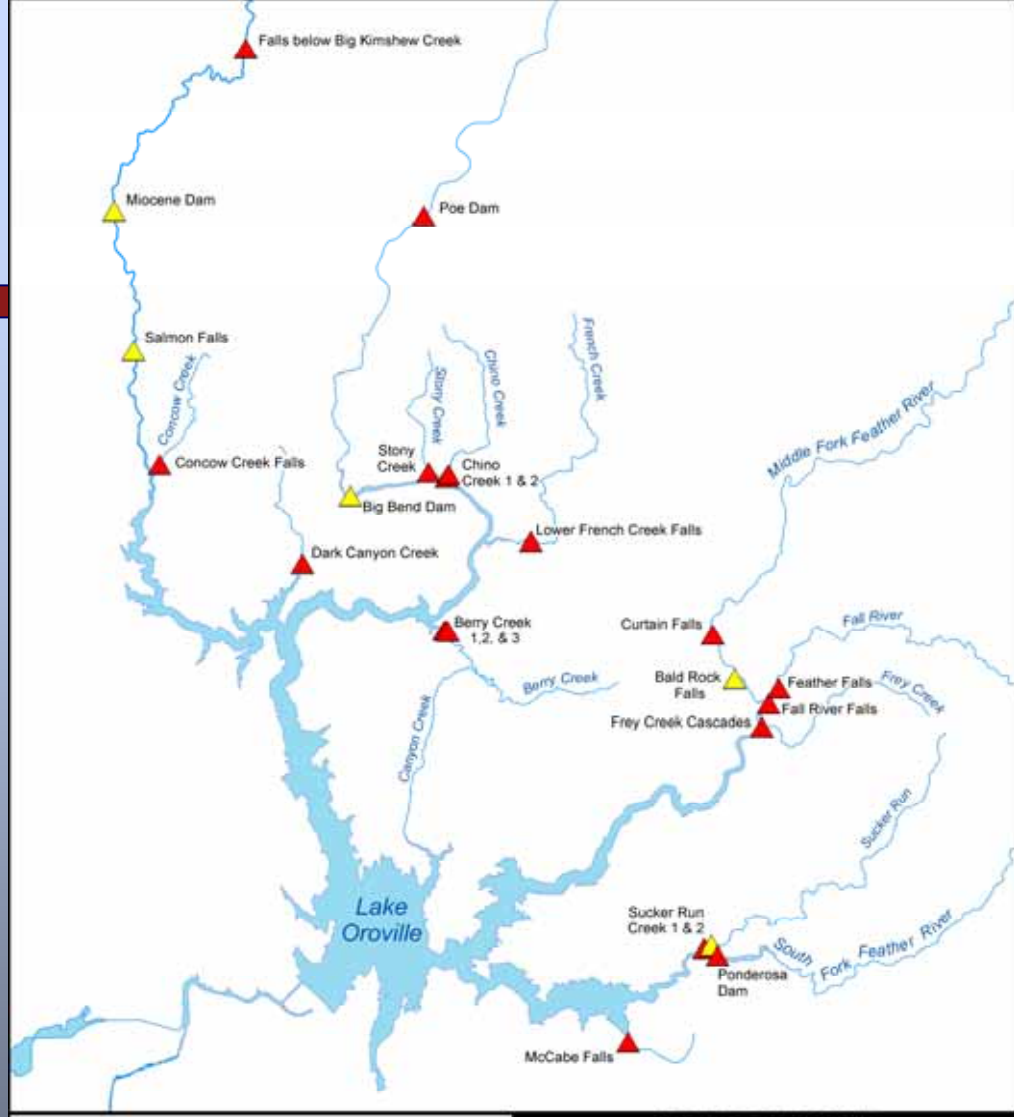
SP-F15 Task 2

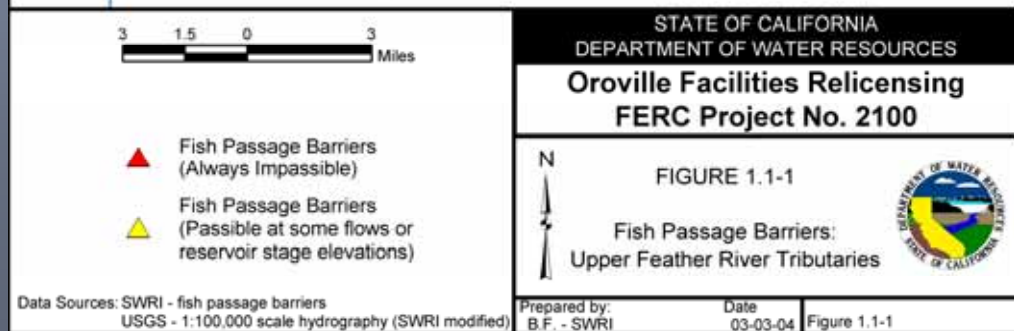
- **Fish Passage Barriers/Geographic Scope – SP-F3.1 Task 1A**
- **Upstream Tributary Fish Species Composition and Distribution – SP-F3.1 Task 1B**
- **Mesohabitat Surveyed – SP-G1**
- **Water Temperatures – SP-W6**
- **Tributary Flows**

SP-F15 Task 2

Geographic Scope / Fish Barrier Locations

SP-F3.1 Task 1A

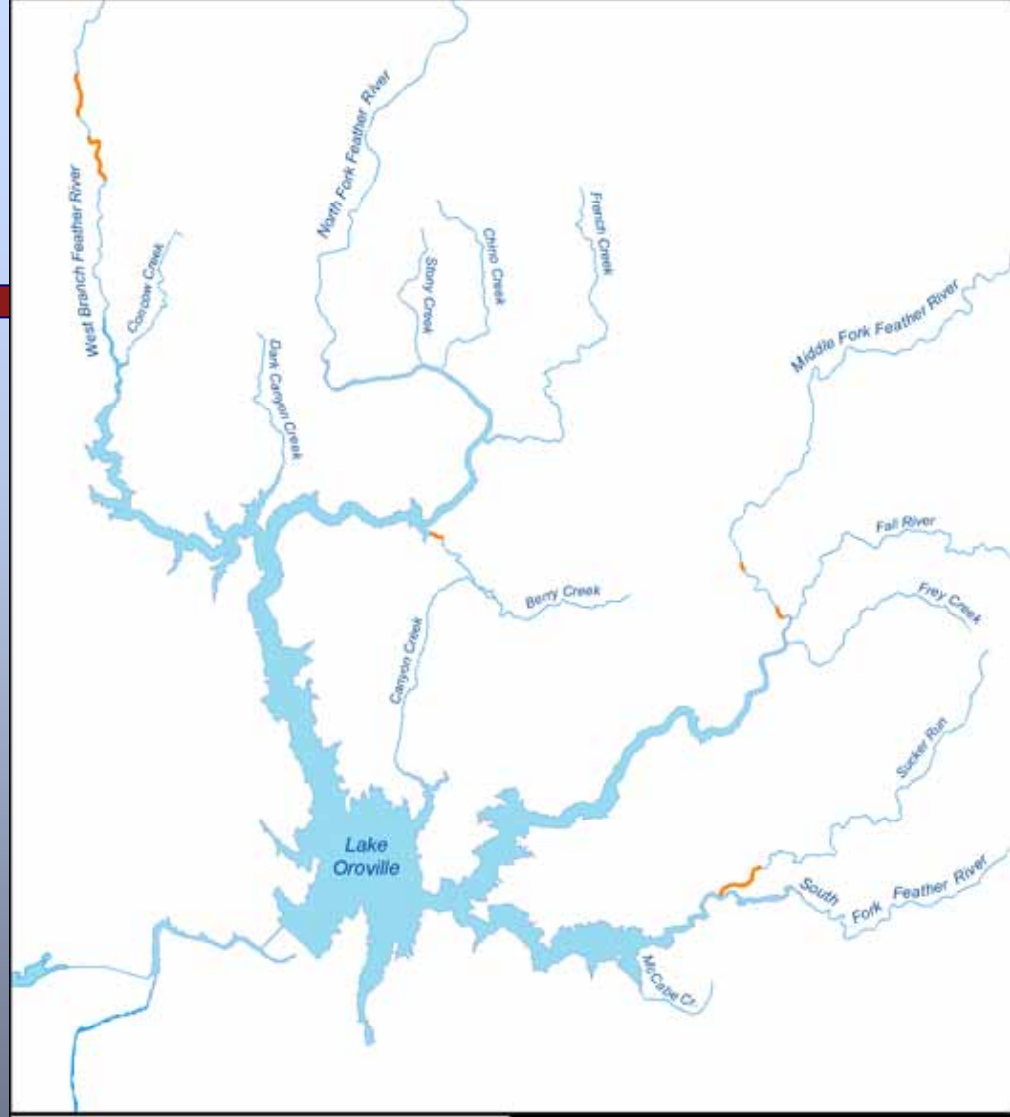




SP-F15 Task 2

Upstream Tributary Fish Species Composition Survey Locations

SP- F3.1 Task 1B



SP-F15 Task 2

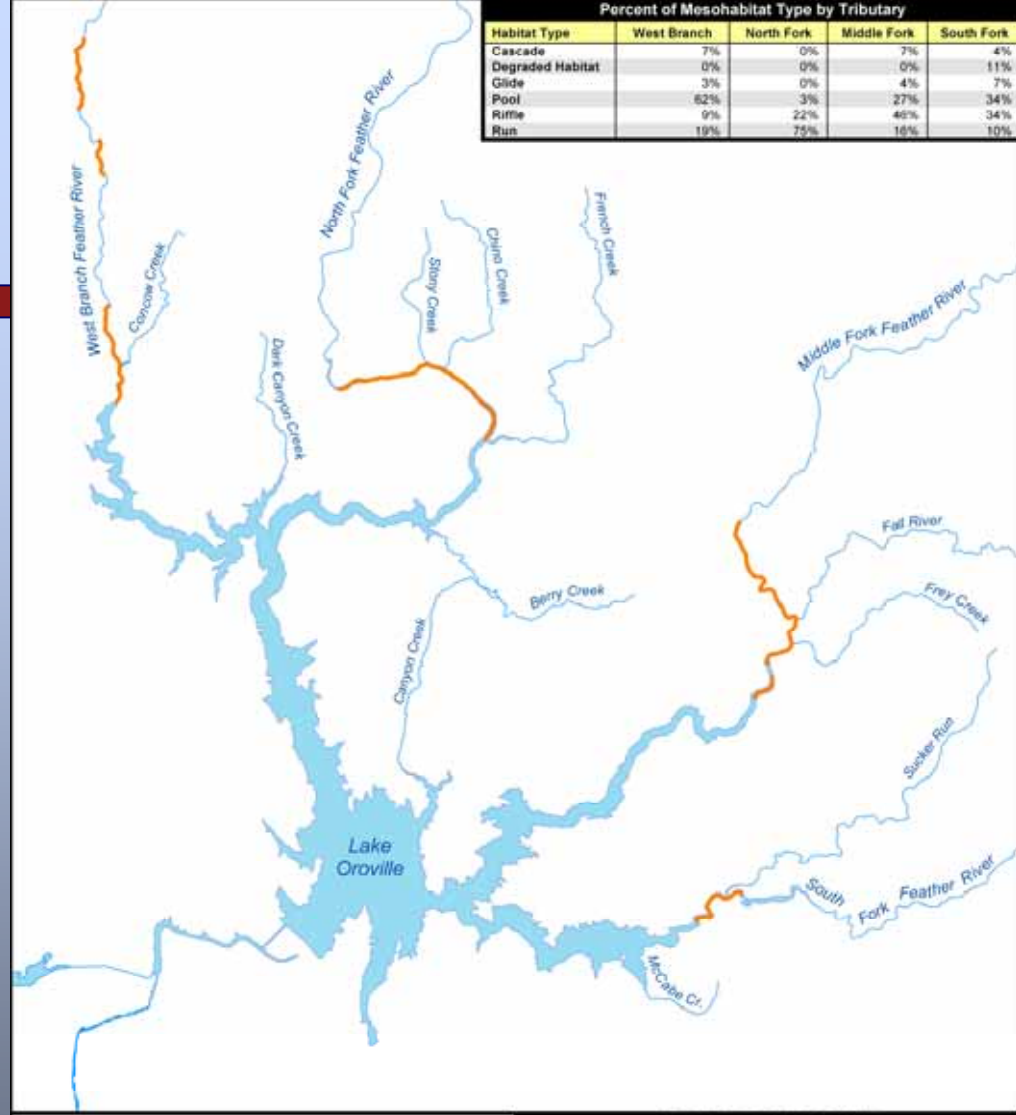
- **Rainbow trout were observed at all upstream fish survey locations, but not at all observations at each location**
- **Because rainbow trout, steelhead, and Chinook salmon are closely related, suitable habitat likely exists for anadromous steelhead and Chinook salmon in the tributaries upstream of Lake Oroville.**

SP-F15 Task 2

Mesohabitat

Surveyed

SP- G1



SP-F15 Task 2

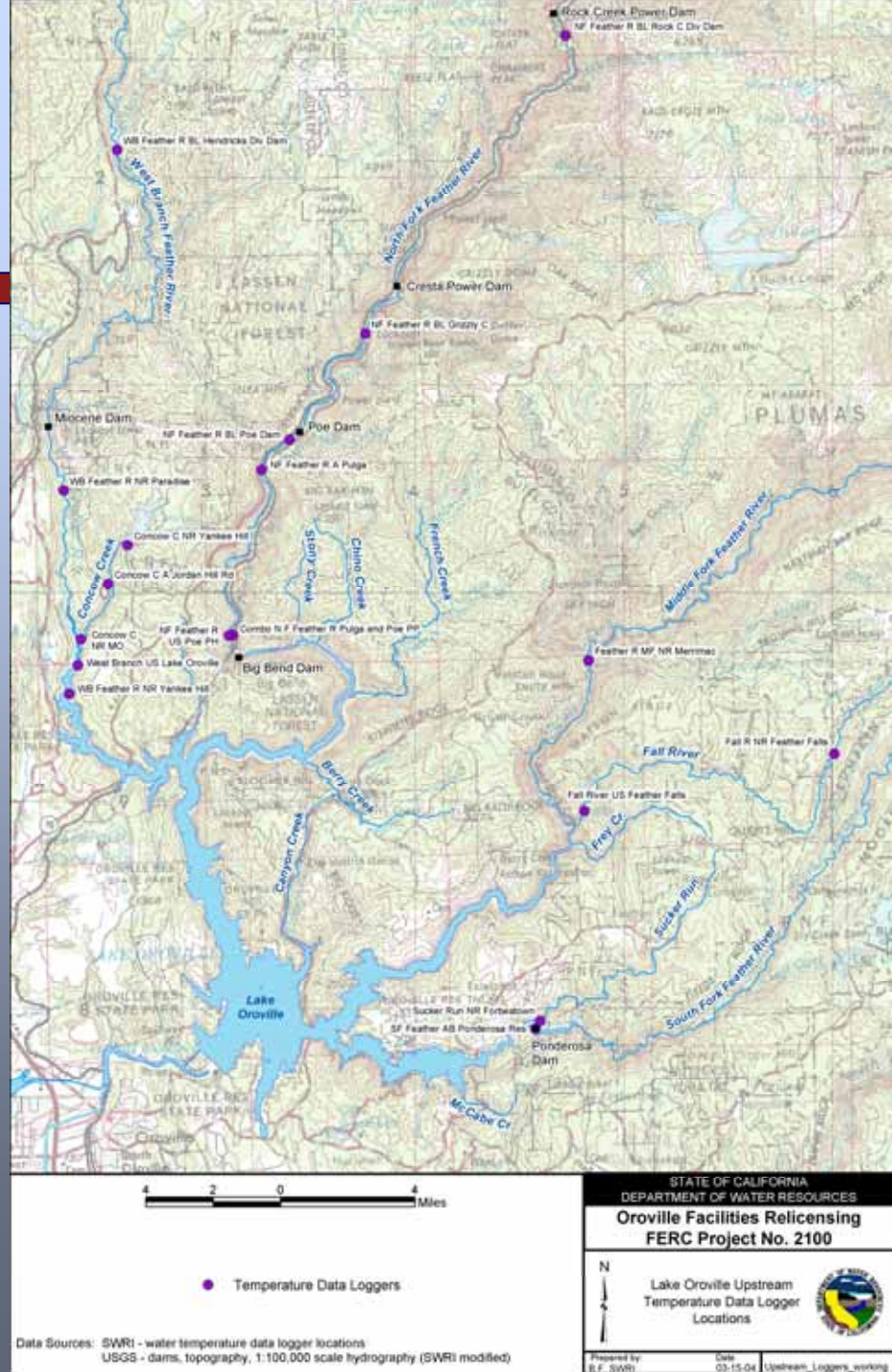
- **Based on surveyed Mesohabitat types, the upstream tributaries above Lake Oroville and below the first fish barriers potentially provides suitable habitat for all life stages of Chinook salmon and steelhead.**
- **Spawning and embryo incubation life stage, for both Chinook salmon and steelhead, is the life stage for which the least amount of suitable habitat is available.**

SP-F15 Task 2

Tributary Flows

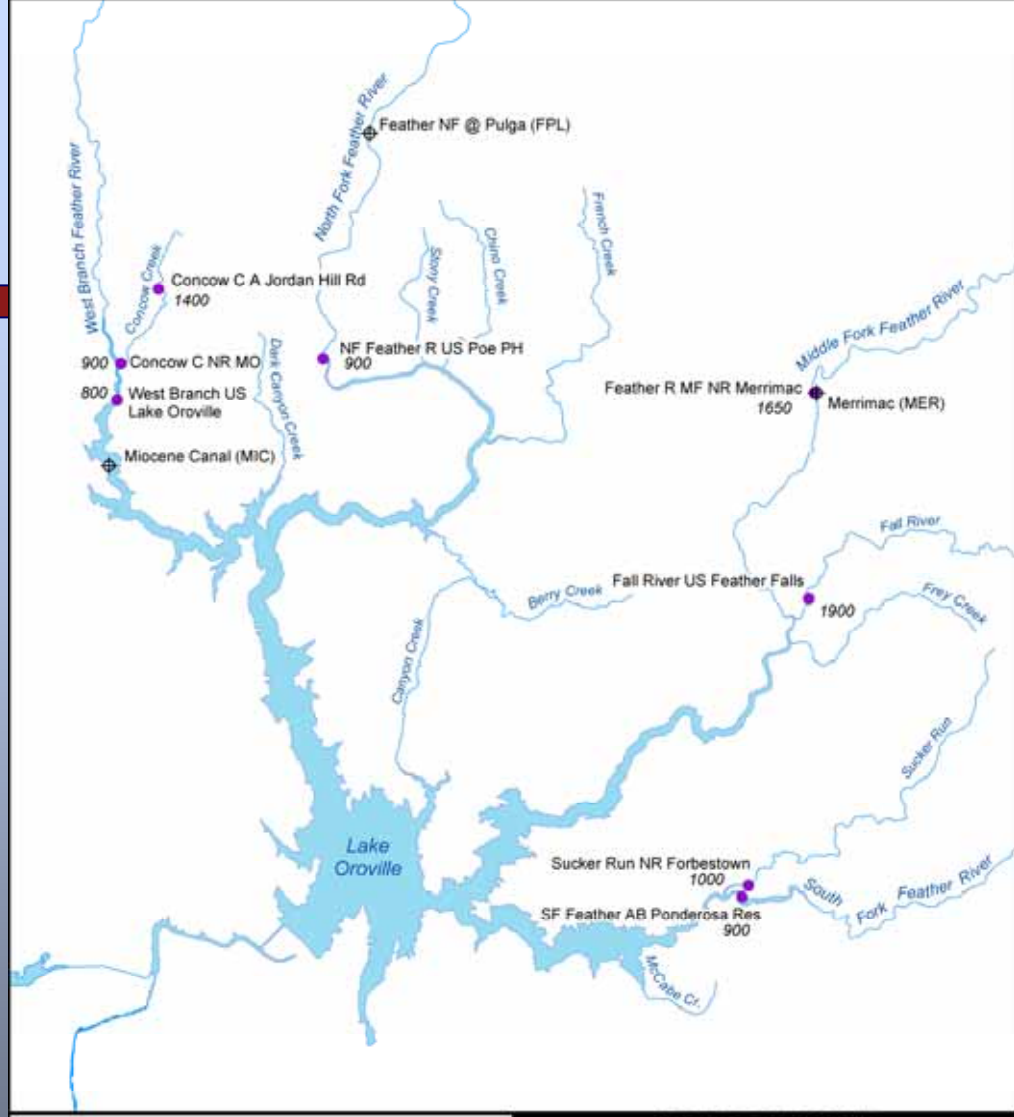
Gage Station

Locations

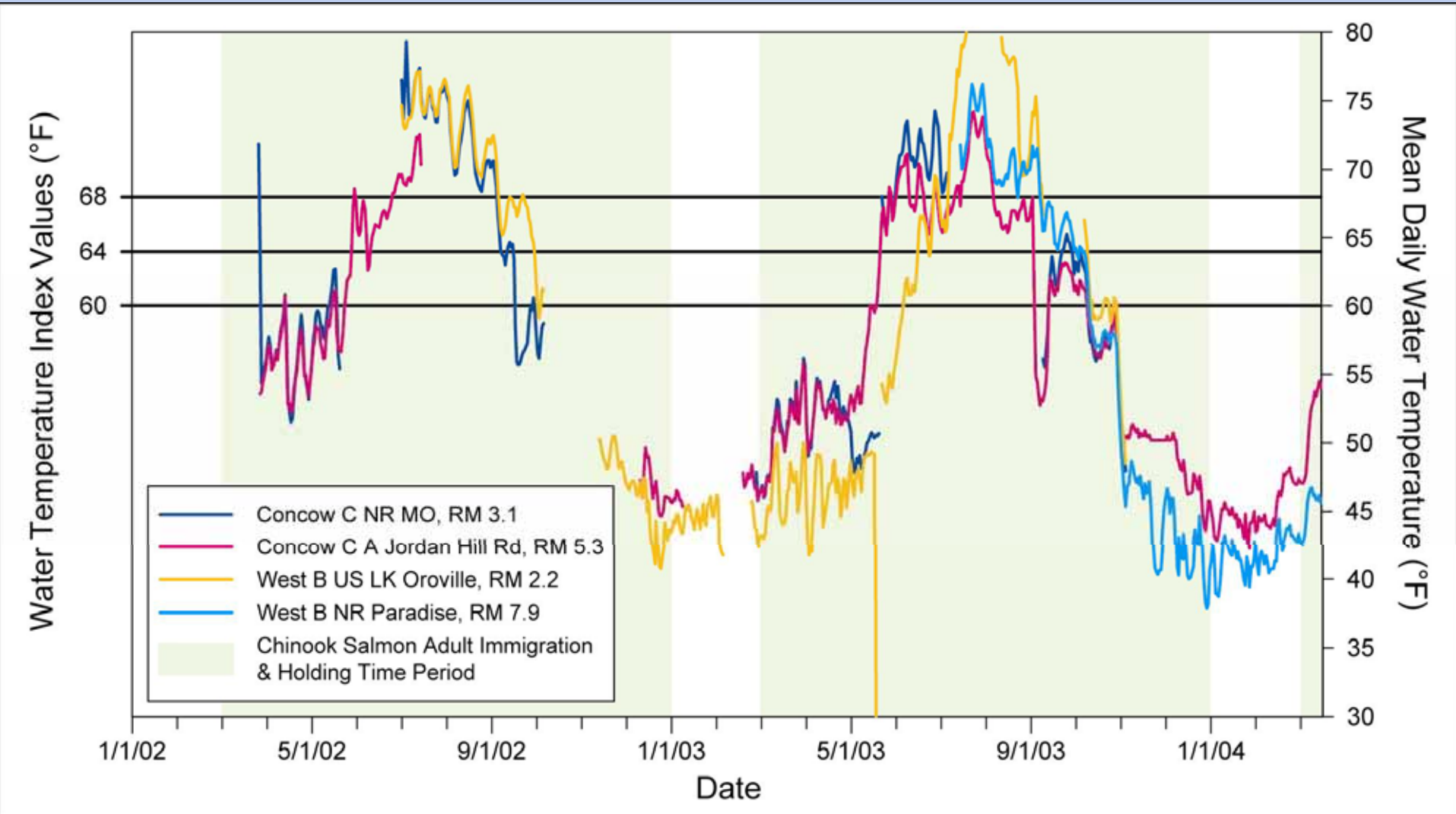


SP-F15 Task 2

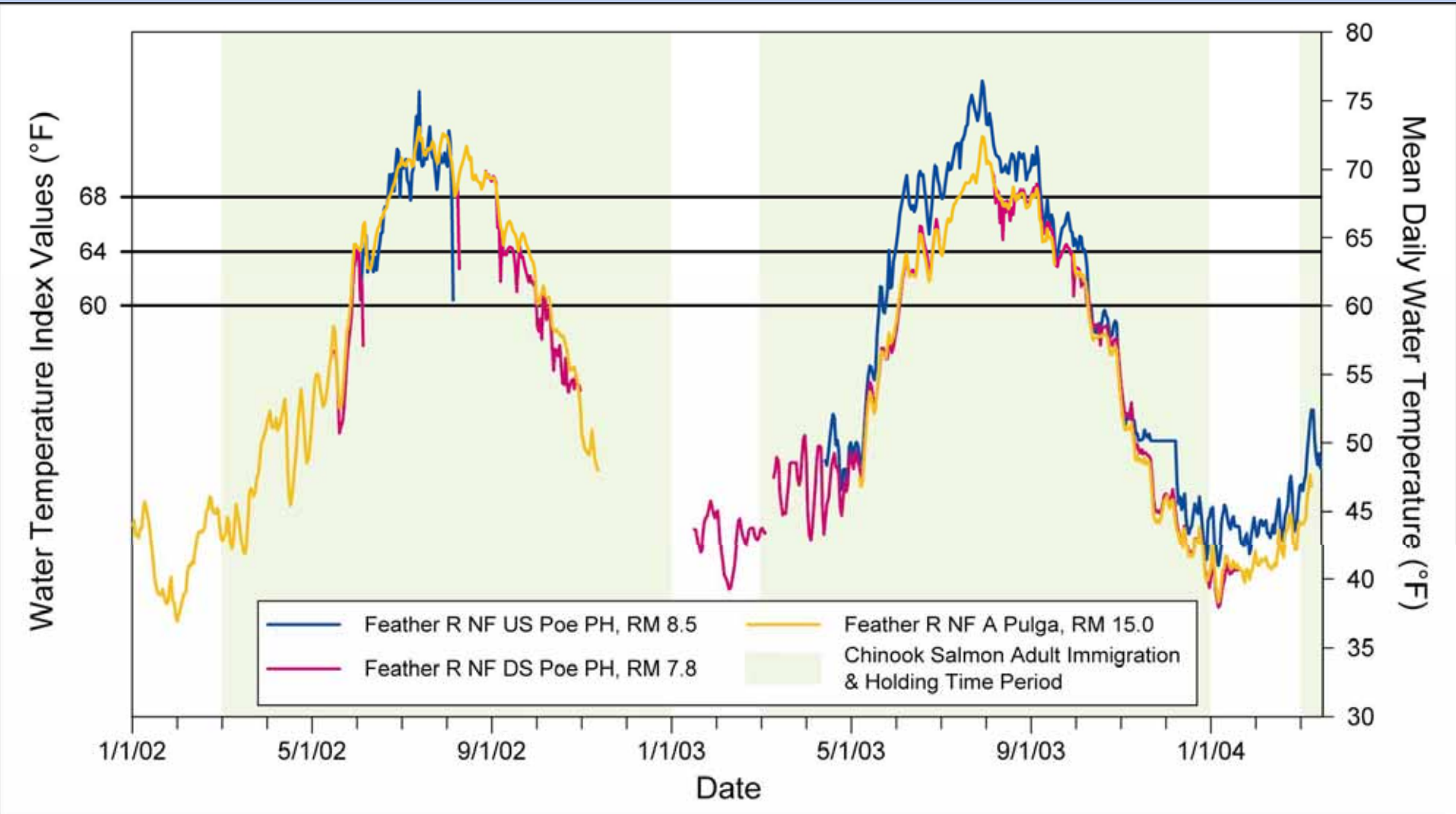
Water Temperature Logger Locations



West Branch Water Temperatures: Chinook Salmon Immigration and Holding



North Fork Water Temperatures: Chinook Salmon Immigration and Holding



Upstream Water Temperatures: Immigration and Holding

- **Thermal stress to immigrating and holding Chinook salmon likely occurs from June through early September when mean daily water temperatures in the the West Branch and North Fork Feather River exceeded 60ºF (15.6ºC).**
- **The entire population of Chinook salmon transported into the upper Feather River by a fish passage program would be exposed to potentially stressful high water temperatures from June through early September.**
- **It is currently unknown if thermal refugia are available in the upstream tributaries of Lake Oroville.**

Chinook Salmon Adult Holding and Immigration 60°F Index Value

Maximum water temperature for adults holding, while eggs are maturing, is approximately 59-60 ºF (NOAA Fisheries 1997); Acceptable water temperatures for adults migrating upstream range from 57º to 67 ºF (NOAA Fisheries 1997); Upper limit of the optimal water temperature range for adults holding while eggs are maturing is 59°F to 60°F (NOAA Fisheries 2000); Many of the diseases that commonly affect Chinook become highly infectious and virulent above 60 ºF (ODEQ 1995); Mature females subjected to prolonged exposure to water temperatures above 60°F have poor survival rates and produce less viable eggs than females exposed to lower water temperatures (USFWS 1995)

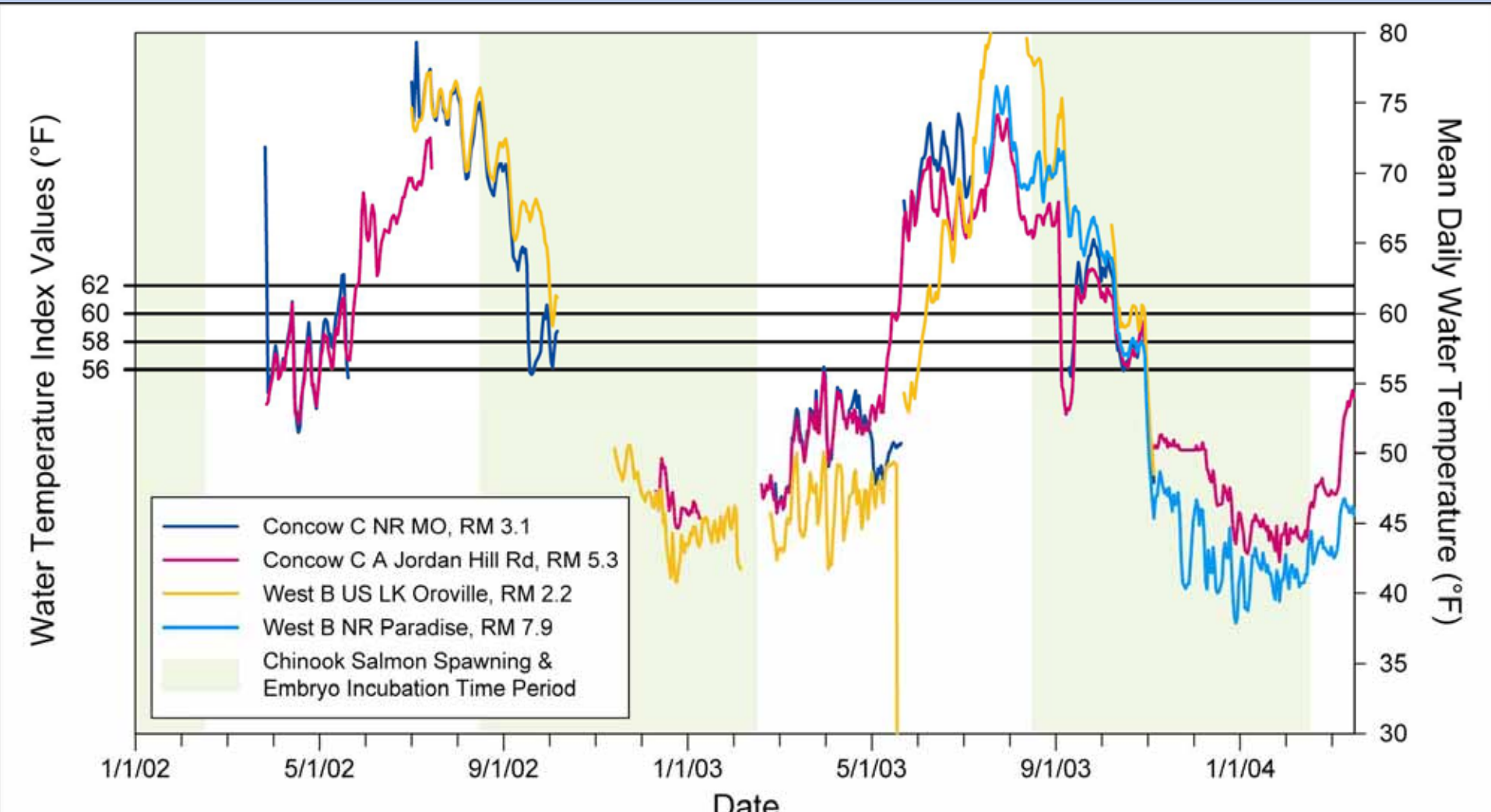
Chinook Salmon Adult Holding and Immigration 64°F Index Value

Acceptable range for adults migrating upstream range from 57º to 67 ºF (NOAA Fisheries 1997); Disease risk becomes high at water temperatures above 64.4°F (EPA 2003); Latent embryonic mortalities and abnormalities associated with water temperature exposure to pre-spawning adults occur at 63.5°-66.2°F (Berman 1990)

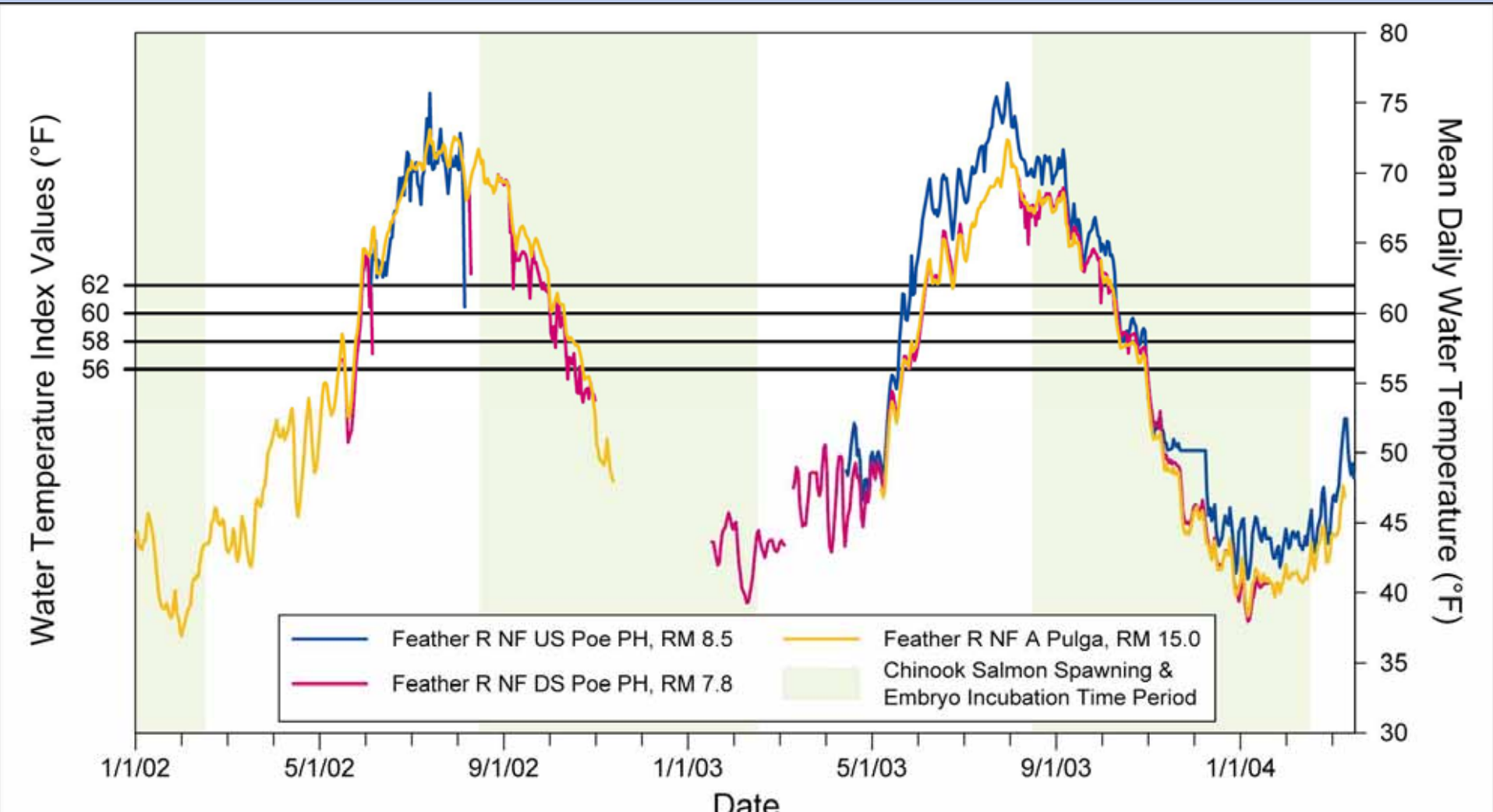
Chinook Salmon Adult Holding and Immigration 68°F Index Value

Acceptable range for adults migrating upstream range from 57º to 67 ºF (NOAA Fisheries 1997); For chronic exposures, an incipient upper lethal water temperature limit for pre-spawning adult salmon probably falls within the range of 62.6°F to 68.0°F (Marine 1992); Spring-run Chinook salmon embryos from adults held at 63.5-66.2°F had greater numbers of pre-hatch mortalities and developmental abnormalities than embryos from adults held at 57.2°-59.9°F (Berman 1990); Water temperatures of 68°F resulted in nearly 100% mortality of Chinook salmon during columnaris outbreaks (Ordal and Pacha 1963)

West Branch Water Temperatures: Chinook Salmon Spawning and Egg Incubation



North Fork Water Temperatures: Chinook Salmon Spawning and Egg Incubation



Upstream Water Temperatures: Spawning and Egg Incubation

- **During Chinook salmon spawning and embryo incubation life stage, mean daily water temperatures in the West Branch and North Fork Feather River exceeded 62^{o}F generally from August 15 through early September to mid-October.**
- **High mortality rates of fertilized eggs and alevin reportedly can be expected when water temperatures exceed 62^{o}F (17.8^{o}C).**

Chinook Salmon Spawning and Egg Incubation 56°F Index Value

Less than 56°F results in a natural rate of mortality for fertilized Chinook salmon eggs (USBR 2003b); Optimum water temperatures for egg development are between 43°F and 56°F (NOAA 1993); Upper value of the water temperature range (i.e., 41.0°-56.0°F) suggested for maximum survival of eggs and yolk-sac larvae in the Central Valley of California (USFWS 1995); Upper value of the range (i.e., 42.0-56.0°F) given for the preferred water temperature for Chinook salmon egg incubation in the Sacramento River (NOAA Fisheries 1997); Incubation temperatures above 56°F result in significantly higher alevin mortality (USFWS 1999); 56.0°F is the upper limit of suitable water temperatures for spring-run Chinook salmon spawning in the Sacramento River (NOAA Fisheries 2002); Water temperatures averaged 56.5°F during the week of fall-run Chinook salmon spawning initiation on the Snake River (Groves and Chandler 1999)

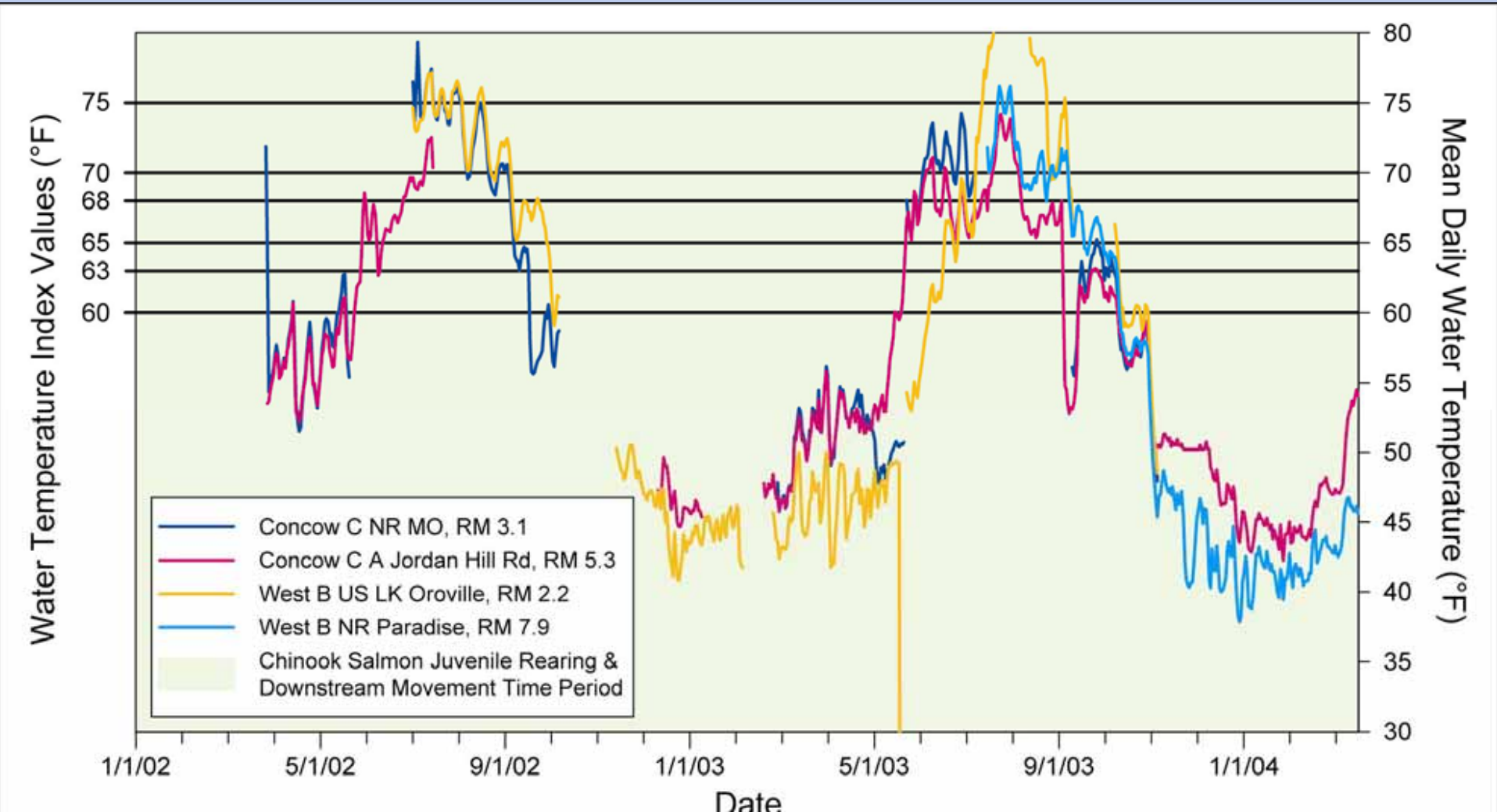
Chinook Salmon Spawning and Egg Incubation 60°F Index Value

100% mortality occurs during yolk-sac stage when embryos are incubated at 60°F (Seymour 1956); An October 1-October 31 water temperature criteria of less than or equal to 60°F in the Sacramento River from Keswick Dam to Bend Bridge has been determined for protection of late incubating larvae and newly emerged fry (NOAA Fisheries 1993); Mean weekly water temperature at first observed Chinook salmon spawning in the Columbia River was 59.5°F (Dauble and Watson 1997); Consistently higher egg losses resulted at water temperatures above 60.0°F than at lower temperatures (Johnson and Brice 1953)

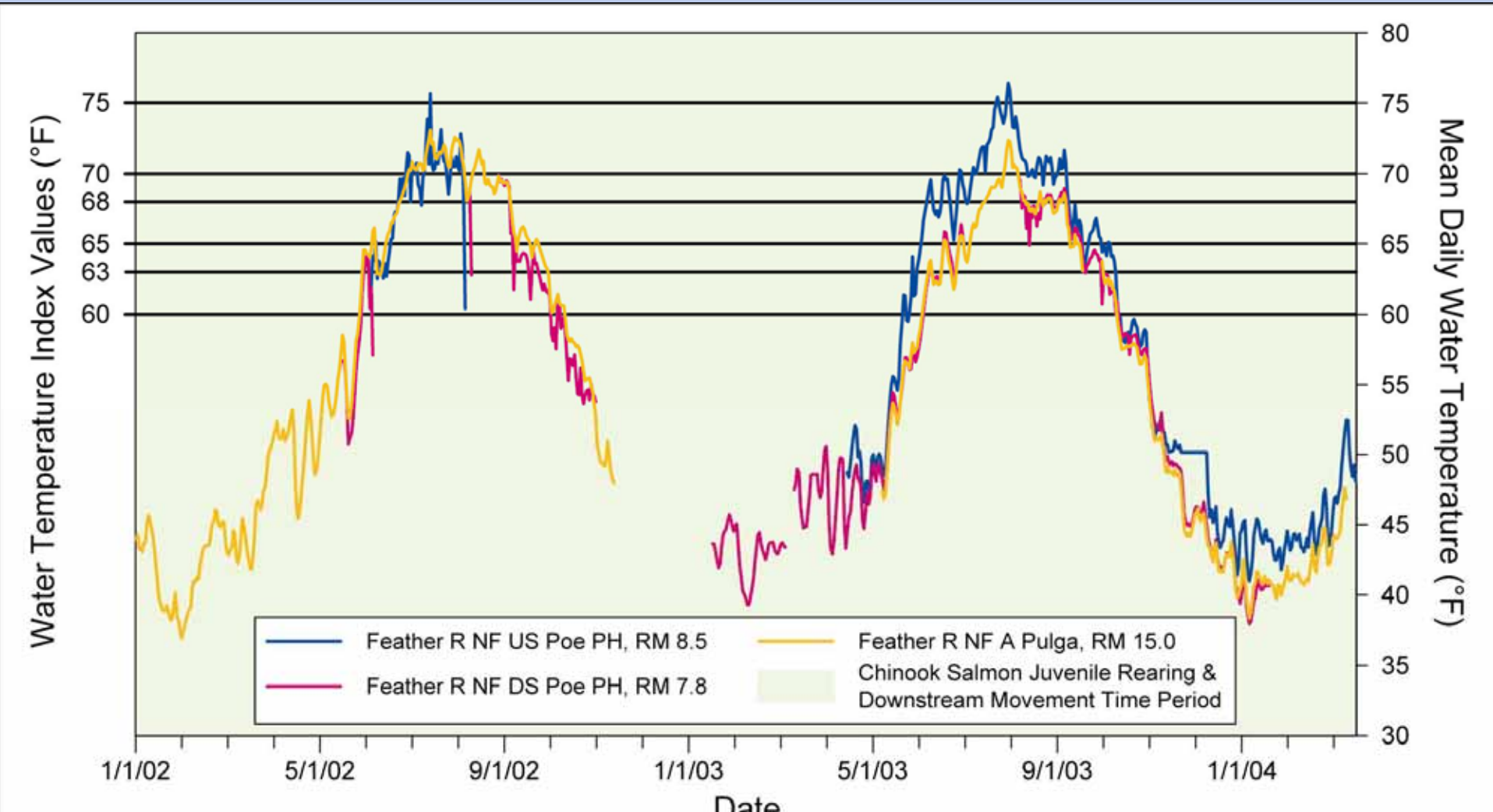
Chinook Salmon Spawning and Egg Incubation 62°F Index Value

100% mortality of fertilized Chinook salmon eggs after 12 days at 62°F (USBR 2003); Incubation temperatures of 62-64°F appear to be the physiological limit for embryo development resulting in 80-100% mortality prior to emergence (USFWS 1999); 100% loss of eggs incubated at water temperatures above 62°F (Hinze 1959); 100% mortality occurs during yolk-sac stage when embryos are incubated at 62.5°F (Seymour 1956)

West Branch Water Temperatures: Chinook Salmon Juvenile Rearing



North Fork Water Temperatures: Chinook Salmon Juvenile Rearing



Upstream Water Temperatures: Chinook Salmon Juvenile Rearing

- **West Branch mean daily water temperatures occasionally exceeded 75ºF (23.9ºC) during July and early August, exceeded 68ºF (20ºC) generally from June through mid-September, and exceeded 63ºF (17.2ºC) from mid-May through September.**
- **North Fork mean daily water temperatures exceeded 68ºF generally from June through early September. Mean daily water temperatures exceeded 63ºF generally from late May through early October.**
- **Exposure to water temperatures above approximately 63ºF could reportedly result in increased mortality and acceleration and inhibition of Chinook salmon smolt development.**

Chinook Salmon Juvenile Rearing and Downstream Immigration 60°F Index Value

- **≤60ºF are optimal for growth (Banks et al. 1971; Brett et al. 1982; Marine 1997; NOAA Fisheries 1997; NOAA Fisheries 2000; NOAA Fisheries 2002; Rich 1987).**

Chinook Salmon Juvenile Rearing and Downstream Immigration 63°F Index Value

- **Elevated water temperature has been reported to inhibit gill ATPase activity, which reduces saltwater tolerance, potentially decreasing survivability and increasing mortality rates (Marine 1997; Zaugg and Wagner 1973).**

SP-F15 Task 2 – Salmonid Habitat Suitability Summary

- **At certain times of the year, mean daily water temperatures in the upper Feather River appear to be unsuitable for Chinook salmon and steelhead.**
- **Degree of unsuitability varied in severity and duration and proportion of population exposed for different salmonid life stages.**
- **Upstream tributaries generally appear to be suitable for migratory Chinook salmon and steelhead based on the collective assessment of available mesohabitat data and the current distribution of resident rainbow trout populations.**

SP-F15 Task 3

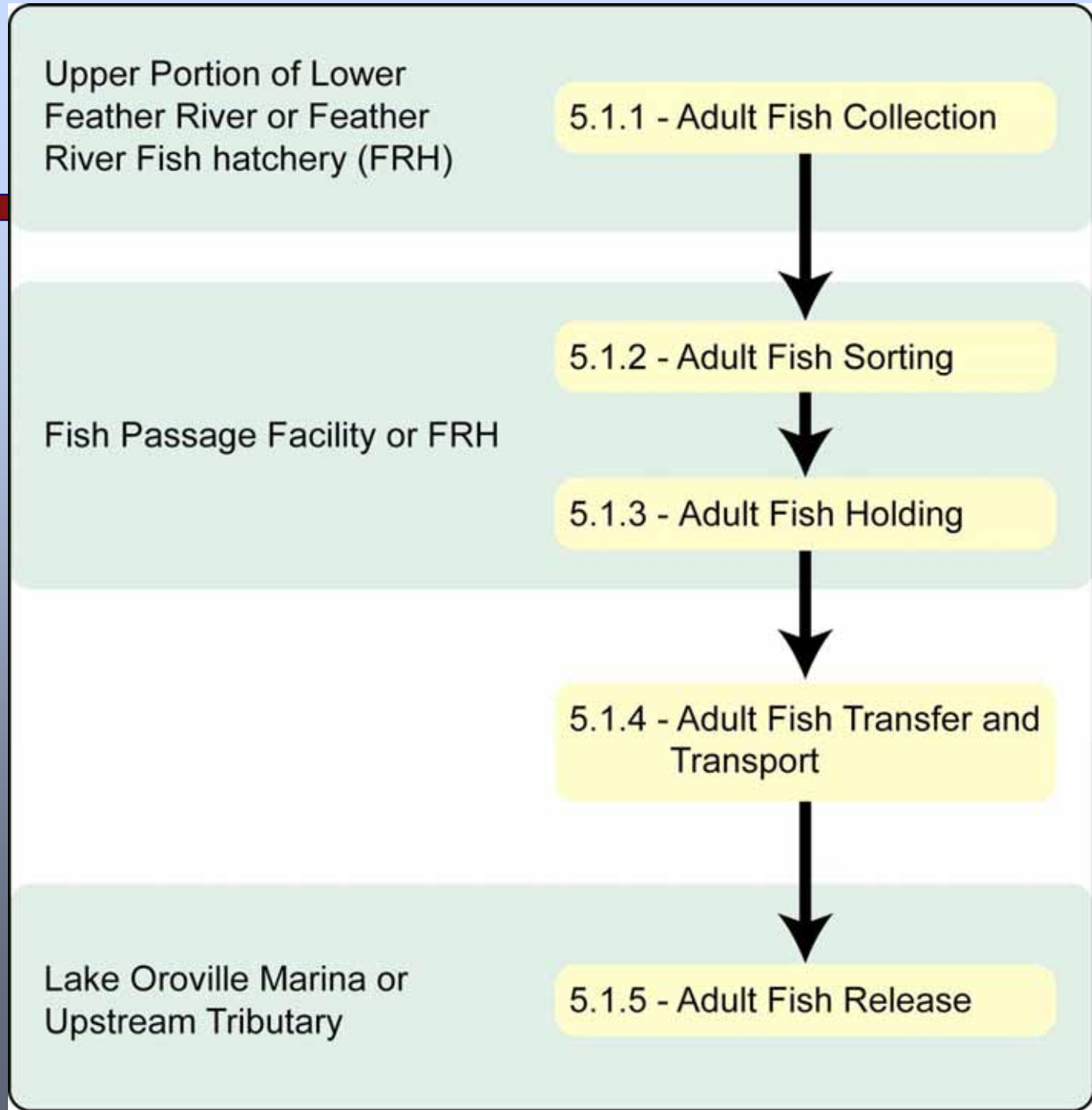
- **Evaluation of Fish Passage Devices and Methods**
- **Includes Task 4A – Description of Facility Structures and Physical Conditions**
- **Includes Task 4B – Biological/Ecosystem Considerations of Fish Passage**

SP-F15 Task 3

- **Report mainly oriented to Chinook salmon passage evaluation due to preponderance of applicable literature available**
- **Steelhead and sturgeon information was included to the extent applicable literature was available**
- **Elements of the fish passage program were evaluated for their alternatives, interactions, interdependencies, functional requirements, logistics, and characteristics.**
- **Advantages and disadvantages of each program and device alternative are evaluated against their ability to successfully accomplish the potential fish passage program goals.**

SP-F15 Task 3

Adult Fish Passage Elements



SP-F15 Task 3 – Adult Fish Collection

- **Use of the existing hatchery fish ladder is recommended:**
  - **No irreconcilable conflicts to the current hatchery operations have been identified**
  - **Using the existing ladder avoids the cost of construction of new facilities**
  - **The current fish ladder is in the most favorable location for highest capture efficiency**
  - **The fish ladder provides for volitional capture of both Chinook salmon and steelhead**
  - **A fish ladder induces the lowest amount of stress from handling and is the highest capture efficiency of the adult capture options**

SP-F15 Task 3 – Adult Fish Sorting

- **Hand sorting (after appropriate anesthetizing) and hand tag readers are recommended over automated sorting:**
  - **Total number of target fish is low enough to handle manually without the added costs and complexity of automated sorting**
  - **Automated sorting can be added at a later phase of the program if desired when increased numbers of fish would be expected to be passed**

SP-F15 Task 3 – Adult Fish Holding

- **Use of the existing hatchery holding tanks is recommended:**
  - **The current tanks have adequate capacities to accommodate the number of fish anticipated**
  - **No irreconcilable conflicts to the current hatchery operations have been identified**
  - **Avoids the cost of new tank construction**

SP-F15 Task 3 – Adult Fish Transport

- **Trucking is the mode of transport recommended for the passage program:**
  - **Use of trucks for adult fish transport is well understood with low operating risks and readily available equipment sources.**
  - **Use of the same trucks for both adult and juvenile transport at different locations and at different timing of peak utilization increases cost efficiencies.**
  - **Trucking is flexible to operational changes in release locations and is the lowest cost per fish transport option.**

SP-F15 Task 3 – Adult Fish Release

- **“Marina Adult Fish Release” is not recommended for the following reasons:**
  - **Surface water temperatures in Lake Oroville during the later portion of the anticipated early upmigrant Chinook salmon immigration adult release period are warm enough to be harmful to the adult fish briefly exposed**
  - **Adult release in Lake Oroville would provide more opportunity and cumulative disease pressure potential for the FRFH and lower Feather River than the alternative of the adult release in the upstream tributaries**

SP-F15 Task 3 – Adult Fish Release

- **Lake Oroville release provides the potential for straying of program salmon into unrecoverable or incorrect tributaries causing either loss of progeny or genetic contamination of the population in other tributaries (if distinct stocks in different tributaries is a fish passage program goal)**
- **Lake Oroville release provides the potential opportunity for residualization**
- **There was not suitable coldwater habitat in all tributary arms of the lake at all times evaluated. Changes in water temperature management in the lower Feather River may potentially affect the availability and distribution of coldwater pool habitat in the reservoir in the future.**

SP-F15 Task 3 – Adult Fish Release

- **Release of ESA listed species into Lake Oroville would likely require changes in the fishing regulations and could potentially reduce the management flexibility of the stocked coldwater fishery**
- **Operation of surface flow collectors in the tributary arms of the reservoir with their associated guide nets may effectively block adult immigration through the juvenile emigration period (mid-November through June), which may not be a conflict if the adults are placed upstream of the surface flow collector locations in the tributary arms or if the adults hold in the reservoir until after the juvenile collection period is completed.**

SP-F15 Task 3 – Adult Fish Release

- Water temperatures in the lake epilimnion and tributary inflow temperatures could potentially present potential thermal barriers to salmonid immigration
- Sediment wedges in the upstream tributary arms of the reservoir could present a migration barrier or delay upstream migration during some years
- Big Bend Dam on the North Fork Feather River would only passable by immigrating adults during periods when Lake Oroville is at full pool or near full pool conditions, which may effectively block or delay upstream migration during some years

SP-F15 Task 3 – Adult Fish Release

- **Salmon Falls and Miocene Dam on the West Branch are only passable to immigrating adults during periods of high tributary flows, which may effectively block or delay upstream migration during some years**

SP-F15 Task 3 – Adult Fish Release

- **Miocene Dam on the West Branch is recommended as a potential adult release location.**
  - **It is the farthest downstream location with identified road access above the Oroville reservoir for the West Branch**
  - **Provides access to the most quantity of potential spawning and rearing habitat**
  - **Is the site of the most favorable location for juvenile fish capture using an off-channel fish screening facility**
  - **Higher flows just upstream of the Miocene Canal Diversion provide increased likelihood of suitable water temperatures for salmonid holding and spawning**

SP-F15 Task 3 – Adult Fish Release

- **Upstream of the Poe Powerhouse on the North Fork is recommended as a potential adult release location.**
  - **Has the best road access available in the North Fork**
  - **Provides access to the most quantity of potential spawning and rearing habitat**
  - **Is the site of the most favorable location for juvenile fish capture using off-channel fish screens**

SP-F15 Task 3 – Adult Fish Release

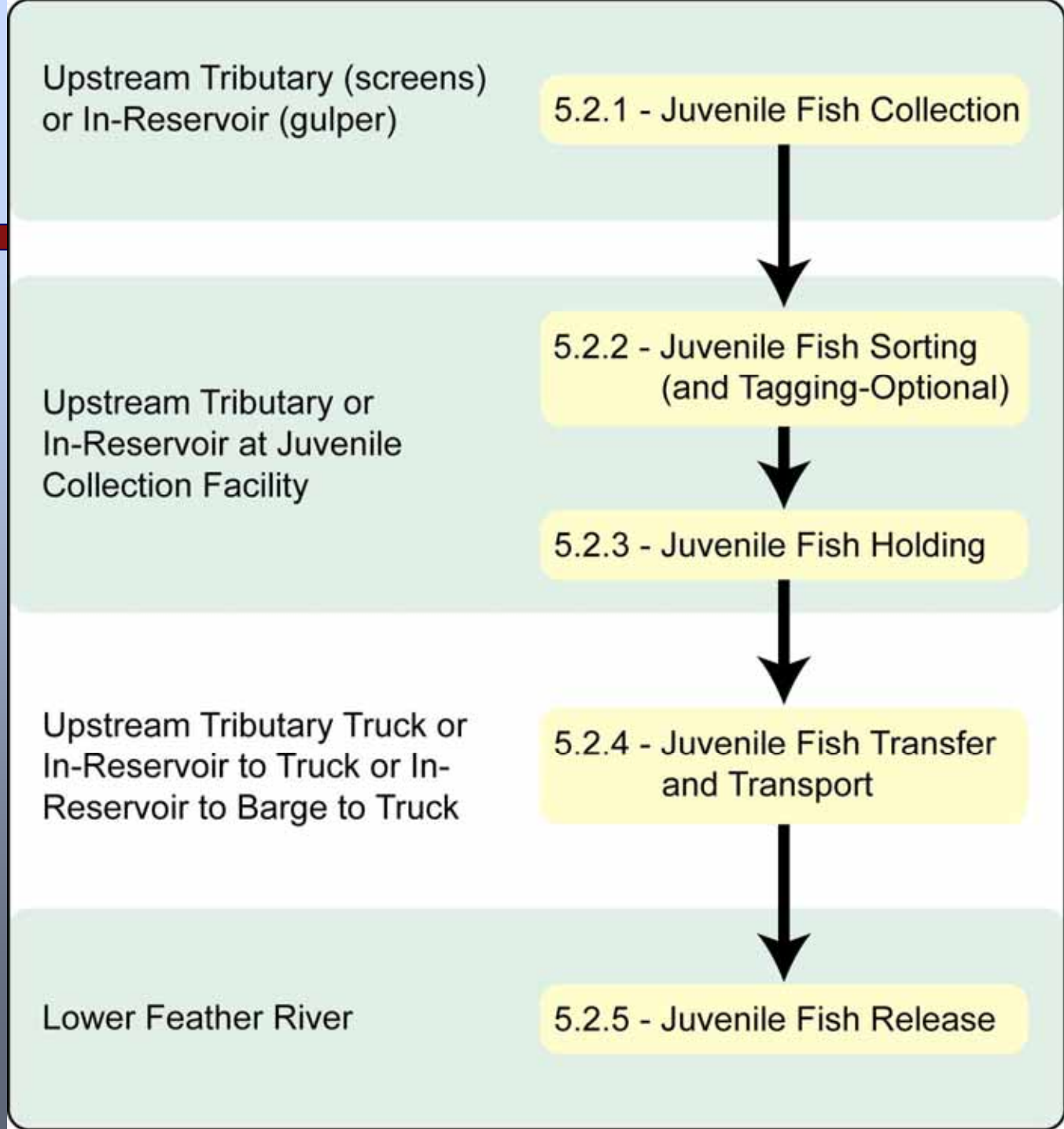
- **The Middle Fork is not recommended for adult release**
  - **There is no road access to the Middle Fork above Lake Oroville high pool and below the first upstream impassable fish barrier.**
  - **Tributary flows during juvenile emigration and steep terrain make the feasibility of tributary juvenile collection facilities unlikely.**
  - **Capture of juvenile outmigrants using only a gulper system in the reservoir would result in low fish passage program production efficiencies. Gulpers reportedly have 22% to – 79% capture efficiencies, which would not be conducive to establishing a successful rate of production.**
  - **The Middle Fork is designated as a "wild and heritage trout" stream and a "wild and scenic river".**

SP-F15 Task 3 – Adult Fish Release

- **The South Branch is not recommended as a potential adult release location.**
  - **Spawning habitat is not available above the fluctuation zone and below the first impassable fish barrier in this tributary.**
  - **Juvenile rearing habitat is not available above the fluctuation zone and below the first impassable fish barrier.**
  - **Habitat quality within the fluctuation zone is subject to seasonal and annual availability from reservoir inundation, low tributary flows, little cover and periodic sediment wedge deposition.**

SP-F15 Task 3

Juvenile Fish Passage Elements



SP-F15 Task 3 – Juvenile Fish Collection

- **Surface flow fish collectors, “fish gulpers” are not recommended.**
  - **Comparatively low fish capture efficiencies of 22% to 79% compared to tributary fish screen efficiencies of 95%**
  - **Capital costs of approximately $10,000,000 and annual operating and maintenance costs of approximately $1,300,000 to $2,000,000 per tributary**
  - **Guide nets potentially block upstream migration of adult salmonids released into Lake Oroville**
  - **Guide nets conflict with boating recreation access and boating safety as well as restrict resident reservoir fish movements**

SP-F15 Task 3 – Juvenile Fish Collection

- **Off-channel upstream tributary fish screens are recommended for potential juvenile fish collection.**
  - **High capture efficiencies of 95+%**
  - **If designed to tributary high flows during juvenile emigration, can theoretically capture approximately 93% of emigrating juveniles.**
  - **Operation of “fish gulpers” for supplementary juvenile fish capture is not recommended as only a net increase of approximately 4% in total capture would be expected and it would disproportionately increase the program costs.**

SP-F15 Task 3 – Juvenile Fish Sorting

- **In the beginning of the fish passage program, manual sorting is recommended because the ability to differentiate Chinook salmon fry and par from other species present is considered reliable.**
- **Juvenile fish CWT tagging is recommended for the fish passage program as a tool to monitor and evaluate various elements of the fish passage program performance and efficiencies.**
- **PIT tagging is not recommended, other than for experimental release purposes, due to the cost of tags on the number of juvenile fish anticipated in the program, e.g. at current juvenile release to adult return rates, each adult would represent approximately $1950 in PIT tag costs.**

SP-F15 Task 3 – Juvenile Fish Holding

- **Juvenile fish holding is recommended to occur at each juvenile fish collection location and adjacent to the fish sorting and transfer facilities.**
- **Water to water transfer from holding to transport is recommended to reduce fish stress and handling related mortality.**

SP-F15 Task 3 – Juvenile Fish Transport

- **The recommended transportation option for juvenile fish transport is trucking from the selected upstream tributary capture locations to the lower Feather River.**
- **Truck transport only eliminates one transfer of juveniles from barge to truck and reduces the amount of juvenile fish mortality and costs associated with juvenile fish transport.**
- **Because the juvenile collection option of using surface flow collectors is not recommended, the barge and truck transport option also is not recommended.**

SP-F15 Task 3 – Juvenile Fish Release

- **Juvenile fish release at various locations in the lower Feather River is recommended.**
- **Release locations are recommended to be varied in timing and location to reduce the amount of predation**
- **Location and timing of juvenile fish release should be adaptively managed to maximize juvenile emigration survival.**
- **In-river release reduces straying rates compared to the San Pablo Bay release alternative and avoids the logistical and practicality constraints of net pen barging.**

Biological/Ecosystem Considerations of Fish Passage

- **Fish Diseases**
  - **Exposure Of Hatchery Water Supply to Fish Diseases**
  - **Increased Risk of Fish Kills in Hatchery**
  - **Exposure of Reservoir and Upstream Tributary Fisheries to Disease**
  - **Increased Cumulative Disease Pressure Throughout Downstream Feather River System**

Biological/Ecosystem Considerations of Fish Passage

- **Fish Genetics**
  - **Potential Genetic Introgression of Steelhead With Resident (Non-Native Strains Stocked) Rainbow Trout**
  - **Separation of Spring-Run vs. Fall-Run Chinook**
  - **Potential Removal of Rainbow Trout From Tributaries**
  - **Minimum Number of Fish to Achieve a Genetically Sustainable Population**
  - **Straying Rates Affecting Sustainability of a Genetically Distinct Population**
  - **Access to Habitat Conditions More Closely Approximating Historical Habitat**

Biological/Ecosystem Considerations of Fish Passage

- **Predation**
  - **Predation On and From Resident Fish Population**
  - **Potential Predation Impacts on Other ESA Species**
- **Competition**
  - **Competition with Resident Salmonids for Food and Habitat**

Biological/Ecosystem Considerations of Fish Passage

- **Coldwater Fisheries Management**
  - **Reduction in Manageability and Quality of the Reservoir Salmonid Fisheries**
- **Cross Resource Impacts**
  - **Boating Access and Safety**
  - **Fishing Regulation Changes**
  - **Introduction of ESA Species into New Areas**
  - **Native American Tribal Fishing Rights**

Biological/Ecosystem Considerations of Fish Passage

- **Reproduction/Spawning**
  - **Upstream Nutrient and Energy Transfer**
  - **Reduction in Redd Superimposition and Resulting Egg Mortality in Lower Feather River**
  - **Non-Self Sustaining Coldwater Fishery in Oroville Reservoir**
  - **Increased Total Salmonid Production**
  - **Access to Increased Quantity and Quality of Salmonid Spawning and Rearing Habitat**
  - **Steelhead Post-Spawning Survival**

Biological/Ecosystem Considerations of Fish Passage

- **Risks and Alternative Methods to Accomplish Fish Passage Goals**
  - **“Net” Productivity of the Fish Passage Program**
  - **Opportunity Cost of Loss of Spawning Fish From Lower Feather River**
  - **Risks of Fish Passage Program Failures**
  - **Potential Alternative Methods to Accomplish Passage Program Goals**

Fish Passage Program Feasibility Assessment

- **Before a potential fish passage program is considered feasible, there should be a reasonable expectation that the program would achieve the minimum sustainable goal of a 1:1 adult return to adult passed ratio.**
- **The current fish passage model values and assumptions result in an expected 0.3:1 adult return to adult passed ratio.**
- **The fish passage program would need to perform over 300% better than currently expected in order to meet this minimum sustainable fish passage performance goal.**

Fish Passage Program Feasibility Assessment

- **If reasonable doubt remains on the potential fish passage program performance, then a limited program testing those critical success fish passage program variables to reduce the level of uncertainty could be conducted.**
- **The fish passage model can be used to isolate the performance targets required for each fish passage variable in order to achieve the minimum performance goal.**

Fish Passage Program Implementation Phasing Considerations

- **Other lower cost and lower risk resources actions to accomplish the fish passage program goals should be evaluated as alternatives to the fish passage program or perhaps implemented first to determine the incremental benefit needed to accomplish the resource goals.**
- **In the event that the fish passage program is determined to be feasible as well as cost effective and desirable, the program should be phased into operation to manage the incremental introduction of complexity and capital cost requirements.**

Fish Passage Program Implementation Phasing Considerations

- **Implementation phasing factors of the fish passage program should include:**
  - **Number of adults available to start to initiate the program from the selected target fish. This number of available fish would be determined by the number of fish meeting the program criteria vs. the biological risk of the program to the viability of the remaining population.**
  - **A minimum number of tributaries should initially be selected to accommodate the starting number of fish.**
  - **The first tributary activated in the program should be the one with the best quality habitat and existing compatible infrastructure, which would probably be the North Fork.**

Fish Passage Program Implementation Phasing Considerations

- **Low numbers of fish could be sorted and tagged manually and automated sorting and tagging capabilities and capital investments could be implemented at later phases.**
- **The fish passage program should only be expanded beyond the initial levels if the first returning year class fish indicate a sustainable fish passage program performance. If performance levels are below sustainable levels, the program should be evaluated for opportunities for improvement and those programs should be implemented successfully if the program is to be continued.**
- **Additional tributaries should only be added as the maximum habitat capacity is reached to maximize the utilization efficiency of the fish passage program assets.**

SP-F15 Task 4 - Updates

- **Revisions and improvements to model documentation, assumptions and values used (previously reviewed at 4/29/04 FTF Meeting)**
- **Revised Appendix A – Biological Relationships (incorporates above changes)**
- **All Fish Passage Model comment and responses have been reviewed with the FTF (completed at 4/29/04 FTF Meeting)**
- **Updated Fish Passage Model Cost values and assumptions**
- **Updated Fish Passage Model, version 1.11**

SP-F15 Task 4 – Model Scenario Rationale

- **Definition of "Maximum Biological Performance"**
  - **Both methods of juvenile capture used.**
  - **Upstream screens sized to accommodate 95th percentile flows by tributary during juvenile emigration to maximize capture efficiency.**
  - **No tagging to avoid associated fish mortality.**
  - **North Fork and West Branch both selected (does not effect biological performance, but reduces cost per fish).**
  - **Does not include hatchery water treatment to avoid associated costs attributed per fish.**

SP-F15 Task 4

- **Revisions and improvements to Costs and model values**
  - **Gulper construction costs**
  - **Gulper operational costs**
  - **Gulper support requirements**
  - **Environmental documentation and permitting costs**

SP-F15 Task 4 – Model Review

- **Review biological values used in current model scenario**
- **Review “insensitivity” of model results to value changes to “in-reservoir survival” and “Gulper efficiency”**
- **Discuss model variables contributing to resulting fish passage performance**
- **Review updated values in “User Cost Inputs”**
- **Show model cost summary**